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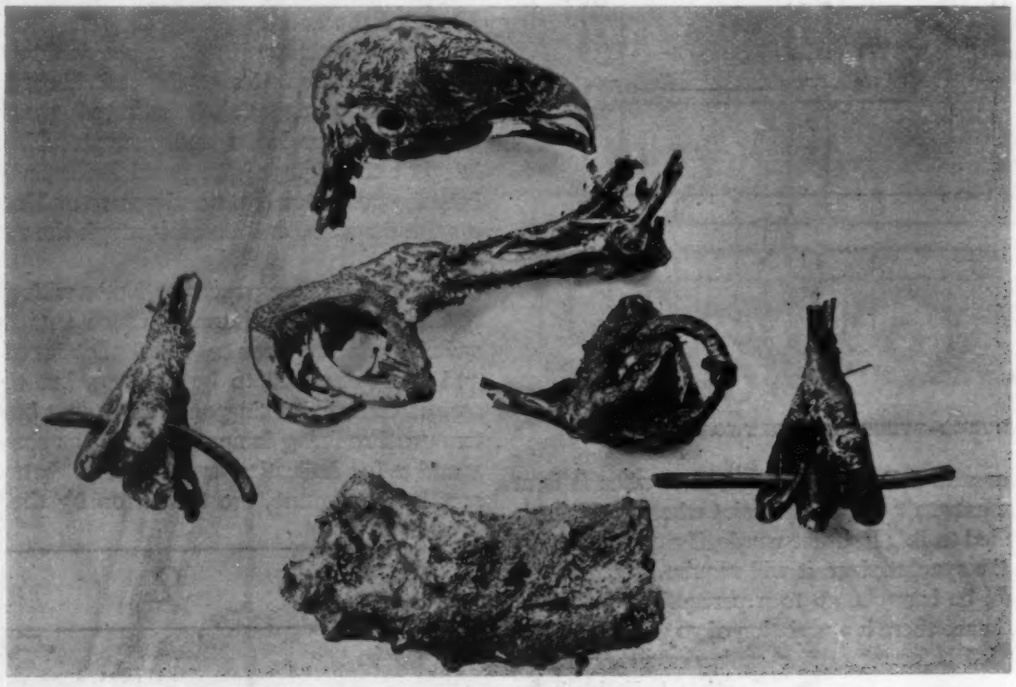
Some Transmission Practices.

GRUESOME indeed are the sanguinary relics here reproduced with the best skill of the engraver's art! They are all that remain of two eagles, which had the temerity to alight on a high potential transmission line of the San Joaquin Electric Company, of Fresno, Cal., and the vindictiveness of the 10,000-volt circuit at the interference is here attested.

To particularize, the transmission plant was running with its usual serenity one day last fall, when, like the traditional thunder-clap from a clear sky, one of the transmission circuits developed a dead short circuit, with the almost instantaneous open-circuiting and grounding of the two legs of the circuit which are on the upper cross arm. This, of course, interrupted the service in Fresno, and the ground thus thrown on was so severe that it became impossible to burn it out. After a few minutes delay, the service was resumed over the second transmission line, which had remained uninjured.



THERE WAS A "HOT TIME" ON THE OLD LINE.

Linemen were sent out at once to ascertain the cause of the trouble and repair the broken circuit, and after having gone over nearly thirty miles of line, they reached a mountain top about five miles from the power house where the break was discovered. As to the cause of it, there were found the scant relics of two grey eagles, consisting merely of one skull and four feet and parts of legs. Two of the talons were clutched tightly to the line wires in literal realization of the grip of death while the remaining two feet and parts of legs were free from the marks of roasting, or rather from the burning to a crisp, that characterized the feet that clutched the wires. Not a vestige of the bodies or feathers of either bird, nor of the head of one of them, could be found—in fact, the only remains were those given in the illustration. Another interesting specimen was found, however, which shows the teriffic heat of the electric arc. The soil along the pole line at the place indicated consists of pure granitic sand, which, wherever the wire touched the ground, had become melted into glass and even a piece of quartz had been fused and run in together with the glass. This is well shown in the specimen presented in the illustration.

The circumstance of the accident suggests a theory for it, as evidently the two eagles alighted on different legs

of the three phase circuit within close proximity to each other; that they actually came into contact and in so doing formed a short circuit which not only incinerated the eagles, but threw the wires into short circuit and burned them off.

The question has been raised as to whether the accident was due to two male eagles battling for supremacy, or whether the short circuit was formed by a "love-lorn billing and cooing pair"—a point upon which yellow journalism may decide.

Part 1

SYNCHRONIZING TWO PHASERS.

Where ever the question of synchronizing devices receives consideration, a point is invariably raised as to whether it is preferable to throw in the synchronizing switch at the moment of maximum brilliancy of the incandescent lamps, or at the moment of their extinguishment. Beyond all peradventure of doubt, the first method is the preferable one, for the reason that a slight variation in voltage is far more readily discernable when the

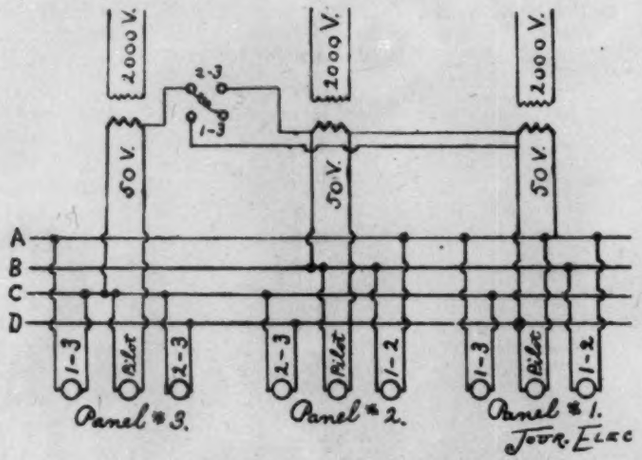
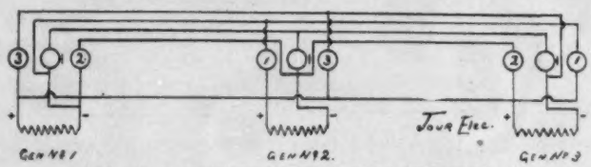


FIGURE 1—SYNCHRONIZING TWO PHASERS.

lamp is at or near full candle power, than when it is at the opposite extremity, or at the point where there is no voltage applied to it. In other words, if a 100-volt lamp is used on the synchronizer, it will require, say, 30 volts before it will be brought up to a perceptible degree of luminosity, hence there is a variation of 30 per-cent in the voltage applied before the eye can discern any variation of voltage whatever. On the other hand, if the lamp is taking 100 volts, the eye will detect a variation of two volts or less in the potential applied, hence the superiority of synchronizing by any method which synchronizes when the lamps are at full candle power, over any method which synchronizes when the lamps are out.

A method of paralleling two phase machines, and as used at the electric power plant of the Blue Lakes Water Company, was described in the Journal for October last and, that its mode of operation may be recalled, it is here reproduced. In two phase systems, the leading phase only is used in synchronizing, and in the mode in use at Blue Lakes City, the leading phase of each generator supplies current to the 2000-volt synchronizing transformer on its respective panel, as shown in the scheme of circuit connections outlined in figure 1. These transformers reduce the generator potential to 50 volts and each has a capacity of 500 watts.

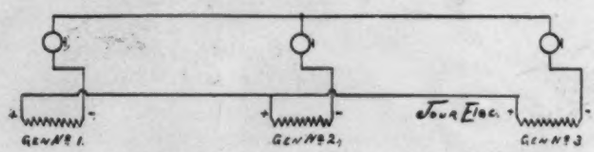
The only portion of the synchronizing equipment that appears on the front of the switchboard is a small U-plug switch, by means of which the circuit combinations of the secondaries of the synchronizing transformers are changed, and three pilot lamps on each of the three generator panels. The center lamp in each case is an ordinary 50-volt pilot lamp for indicating that the dynamo is in operation, and the remaining two



PLAN A—SYNCHRONIZING TWO PHASERS.

outside lamps of each panel are 100-volt lamps for indicating synchronism between its particular generator and either of the other two generators. Referring to panel No. 1 of the accompanying diagram, for instance, the pilot lamp appearing in the center is directly connected across the secondaries of the switchboard transformer. On the lamp at the left is indicated synchronism between generator No. 1 and generator No. 3, while the lamp at the right of the panel indicates synchronism between generator No. 1 and generator No. 2, as appears on the diagram, and so on through the remaining panels.

In synchronizing generator No. 1 with generator No. 2, the U-plug is withdrawn, which cuts out the plug switch from the circuit. The pilot lamps of panels 1 and 2 are assumed to be burning, but the generators are, of course, running on independent bus-bars. The two synchronizing lamps appearing as shown on panels 1 and 2 for indicating synchronism between their respective generators, are turned on by the key sockets.



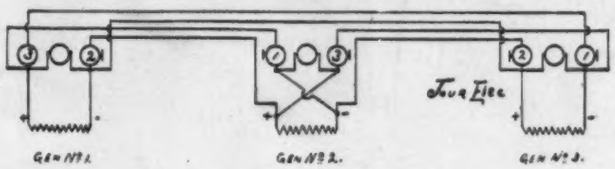
PLAN B—SYNCHRONIZING TWO PHASERS.

This done, the circuit connections of the synchronizing equipment may be readily traced.

It is to be understood that the secondaries of transformers 1 and 2 are coupled in series and feed into the small bus-bars lettered A and B. If now generators 1 and 2 are in synchronism the transformer secondaries will be in phase and their potential being cumulative, will give a pressure of 100 volts across bus-bars A and B. If, however, the generators are out of step, the bus-bar potential will be reduced in direct proportion to the amount of drag in either generator. At intervals

the phases of the two transformers are in direct opposition and the bus-bars consequently have a zero potential. In the next instant the relative positions of the phases may have so changed that the transformers will be in but half opposition, which will give a potential of about 50 volts to the bus-bars, while a fraction of a second later the phases may be in step, giving full potential to the 100-volt lamps, which show synchronism and at the instant the synchronizing lamps reach full candle power, the main switch must be thrown in coupling the generators in parallel.

The U-plug switch is used only in synchronizing generators 1 and 3 and generators 2 and 3, and the use of the switch merely connects the secondaries of trans-



PLAN C—SYNCHRONIZING TWO PHASERS.

formers 1 and 3 and tronsformers 2 and 3 respectively so that the circuits shall be in the same condition as already described for synchronizing generators 1 and 2. There is but one precaution necessary to take, and that is that all synchronizing lamps shall be turned off at the key socket except those used for synchronizing, otherwise it is possible to throw a potential of 150 volts onto the synchronizing lamps of generators 1 and 3, if the U-plug is in the wrong position.

Four other schemes for synchronizing two-phasers are shown in the accompanying diagrams designated as plans A, B, C and D, and in which it is well to note that the horizontal lines in the diagrams are not bus-bars, but merely show the secondary connections from the various synchronizing transformers. In plans A and B, which afford by all means the simplest ways of making connections for any number of generators, the synchronizing lamps are out when the machines are in parallel. Plan C accomplishes the same thing as plan A with the exception that the synchronizing light is at full candle power when the machines are in parallel. Plan D is an arrangement which shows in addition the method of paralleling two sets of generator bus-bars, shown by dotted lines by the use of two extra transformers, in which case the lamps X and Y must be for 100 volts. Obviously synchronizing transformers, may be substituted for the bus-bar connections shown.

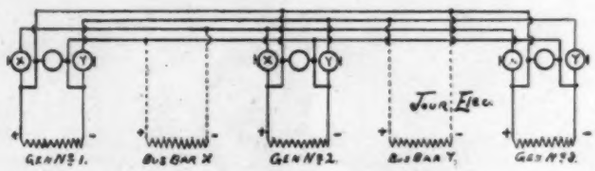
In these diagrams the primary circuit of the transformers are omitted for simplicity, the secondaries being shown as generator terminals direct. The synchronizing lamps are characterized by circles with keys, while the circles containing figures represent single pole switches connecting to the generator circuit indicated.

Part ii

AN HISTORIC TRANSMISSION.

Of great interest is the power transmission plant placed in the Chollar shaft on the Comstock in 1891 for operating the 60-stamps of the Nevada mill. Before that time the Nevada mill consisted of 40 stamps with the usual complement of pans, settlers, etc., which had been run with a 10-foot Pelton water wheel by water supplied from the Gold Hill Water Company's main under a head of 460 feet. When the mill was enlarged to 60 stamps with additional amalgamating machinery, requiring in all some 400 horse-power, the question of securing this power with a degree of economy that would admit of working the low grade ores, was the problem. Fuel being scarce, steam power was out of the question. Water was also expensive, the only source of supply being brought from the Sierras through a pipe line 30 miles in length.

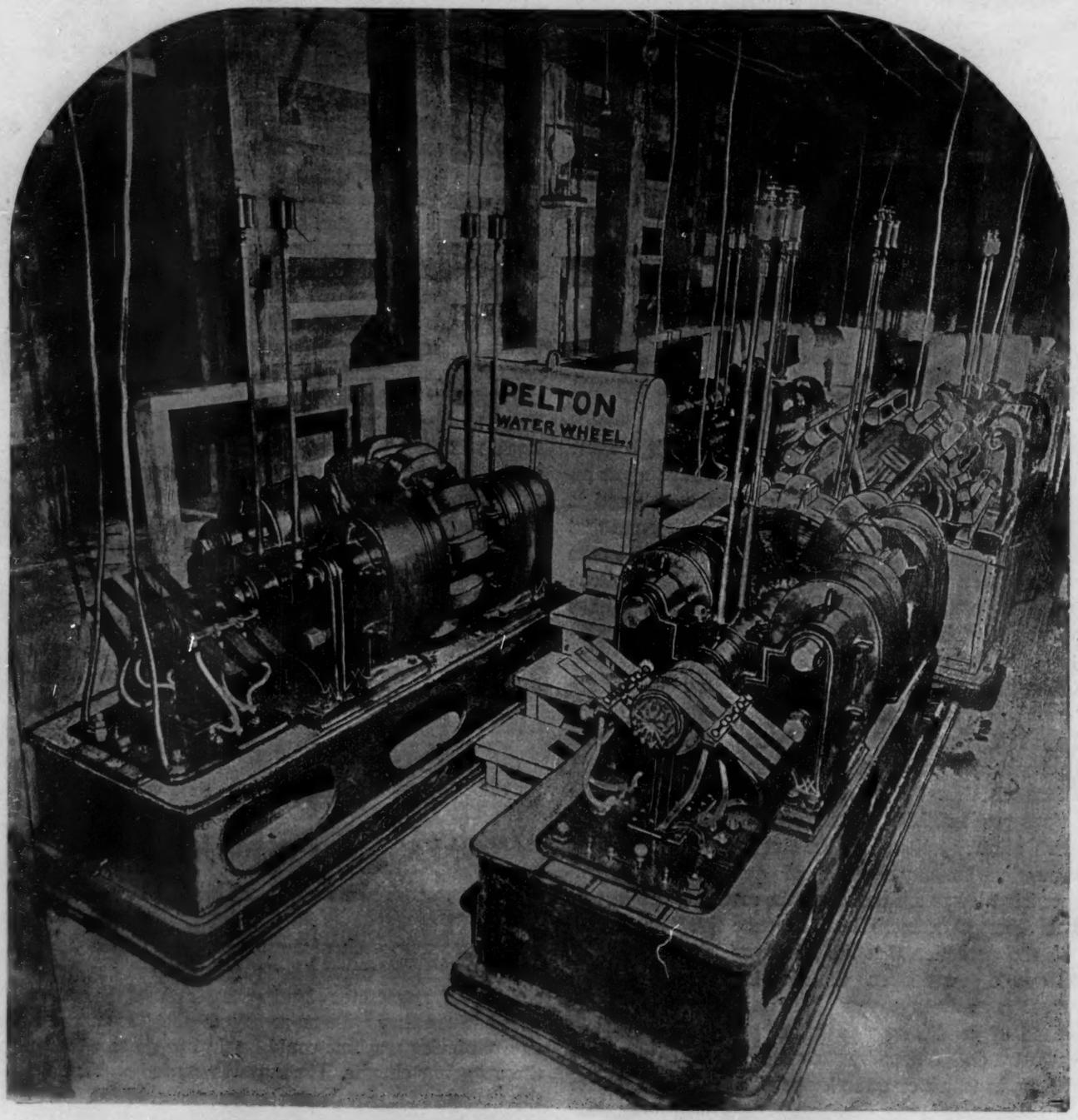
The Sutro Tunnel afforded an outlet some 1,700 feet below the surface, and the utilization of this immense pressure was decided upon in connection with electric transmission, as being the most feasible. A station was made by excavating a chamber at the Sutro Tunnel level, 1,680 feet below the surface, 25 feet in width, by 50 feet in length. In this were located six Pelton wheels 40 inches in diameter, connected to the shafts of the same number of Brush dynamos, both running at a speed of 900 revolutions per minute. These Brush generators were of the constant current type, delivering 30 amperes at a variable electro-motive force. They were compound wound having a high resistance series shunt, with a small series winding merely sufficient to build up enough field to maintain 30 amperes in the series field winding on short circuiting the brushes. The



PLAN D—SYNCHRONIZING TWO PHASERS.

generators were each of a rated capacity of 100 horse-power, while the water wheels were rated at 125 horse power. The generator circuits were taken to the switchboard where they were so arranged that the output of any particular machine could be thrown on to either of the outgoing circuits. The line was carried out through the shaft on glass insulators, and consisted of No. 4 wire covered with special Clark insulation throughout. After leaving the shaft the six circuits were carried to the motor room adjoining the mill, making the total transmission of about one mile. As intimated the six generators were each provided with separate circuits from which were operated six 60-horse-power constant current electric motors of the familiar type of the Brush arc machine. These motors were arranged in a single

row paralleling the main driving shaft to which they delivered power by belting. To this driving shaft was also belted the 10-foot Pelton wheel heretofore referred to as being operated from the Gold Hill water system, and together the six motors and water wheel thus operated the stamp mill. The electric plant was sold by the terrific head under which the plant operates. The water used was taken from the tail race of the 10 foot surface wheel referred to, whence it was piped down the shaft to the intersection with the Sutro Tunnel at the 1680 foot level, where, as stated, the generator room was chiseled out of the solid rock. Here the wheels



POWER ROOM OF THE HISTORIC TRANSMISSION IN THE CHOLLAR SHAFT.

late Geo. H. Roe and was installed under the direction of Mr. F. E. Smith, now Chief Electrician of the San Francisco Gas and Electric Company.

Aside from the interest which is attached to the uniqueness of this electric installation, the hydraulic plant is striking because of the novel use of waste water and the were located and the water of the tail race was carried out to Sutro tunnel. Each of the six water wheels weighs 220 lbs. and delivers 125 horse-power from a jet of water five-eighths of an inch in diameter. The wheels are of phosphor bronze, 40 inches in diameter, and when running without load, have a speed of 1800

revolutions, with a peripheral velocity of 18,864 feet, or more than three and one-half miles per minute. The water is delivered from a nozzle at a speed of 19,260 feet per minute, forming a stream that for all practical purposes is as invulnerable as a bar of steel. Though the plant is now idle, it remained in constant daily use for more than six years and would be in operation today were it not that the mill is closed down.

Part iii

CHANGING INSULATORS ON LIVE LINES.

A method of changing insulators on a 10,000-volt transmission circuit while the current is on the line, is described in a recent number of the "Electrical Review" (N. Y.), and the evident practicability of the scheme will doubtless bring it into favor in the many electrical transmission plants of the Pacific Slope. The electrical transmission plants of the Pacific Slope. The practice which is universal in the West, is to shut down the plant to change an insulator, or, if duplicate transmission lines be provided as is the case at Portland, Sacramento and Fresno, to throw the whole load on to one circuit, while the men are at work on the second one.

The experience has been that if let alone, porcelain insulators give very little trouble on lines carrying potentials between 5,000 and 6,000 volts. In the line of the Nevada County Electric Power Company, which is operated within the limits of voltage given, no attempt is ever made to change insulators when the current is on for the reason that unless the insulator is completely shattered and the wire is on the cross arm, it is not necessary to replace a broken insulator, as "partly broken insulators cause no trouble whatever, even in severe storms," writes Mr. L. M. Hancock, superintendent of the company.

It was with a view of learning the experiences of the different transmission plants in regard to changing insulators on live lines, that letters were addressed to the principal transmission installations of the Coast, and the results of the correspondence which followed are here presented. The prevailing practice is probably well set forth in the letter of Mr. Arthur W. Burt, of the San Antonio plant, who is confident that his company uses "the best method and the only safe one. It is perfectly simple: Never change an insulator or have anything to do with a high tension wire while the current is on. In adhering to this rule, our service has as yet suffered no injury and we shall leave it to others to find some safe method of 'monkeying' with high tension wires."

Mr. E. W. Sutcliffe, electrical superintendent of the Central California Electric Company, states that thus far it has not been found necessary to change insulators on a live high potential line. It has been the custom, in event it became necessary to change an insulator, to shut down between the hours of 12 m. and 1 p. m. and to use a portable telephone on the lines so that notification may be given the power house as soon as the insulator is replaced. This occasions a shut-down of but three or four minutes. "We have lost but thirty-four insulators in eleven months' service," continues Mr. Sutcliffe's letter, "and anticipate but little trouble this winter. Of course, with a change in conditions, we would have to devise some method of handling defective insulators without a shut-down, but we have not found it necessary to do so to date."

Mr. C. W. Hutton, chief electrician of the Sacramento Electric, Gas and Railway Company, related the experience of the Folsom-Sacramento plant as follows:

"As you are aware, we have a double pole line, and our method of changing insulators is simply to shut the current off from the line needing repairs, the only precaution taken being to short circuit and ground the line on which the men are to work. This is done by a piece of wire bent into the shape of the two sides of an equilateral triangle. Small hooks are bent into the two ends of this V-shaped wire in order to engage two of the lines, and the elbow of the triangle is brought into contact with the third line. The triangle is tied by a tie wire to an insulator, and into the insulator a stick about two feet long is screwed, to be used as a handle. A long cable connects the triangle to a steel pin that is driven into the ground before the man goes up the pole to ground the line on which the insulator is to be changed.

"This shorting and grounding was found to be necessary for the reason that on several occasions, linemen have received quite severe shocks while working on a "dead" line while the other was in use. These shocks necessarily give a man a feeling of uneasiness, but no trouble has been experienced since this device has been used, as it is evidently impossible, while using it, for current to be put on to the line by mistake or otherwise. It is certain that no injury can happen to any one who may be working on the wires when so protected."

The maximum potential on the transmission lines of the Portland General Electric Company is about 6,000 volts, and, owing to the multiplicity of circuits between the power houses and the substation, no effort has been made or is likely to be made, toward changing insulators on live lines. Neither has an arrangement yet been made for changing insulators on the 15,000-volt lines of the Pioneer Electric Power Company, of Utah, nor has it ever been the practice of the Big Cottonwood Power Company to remove defective insulators and replace them with good ones on live high pressure lines. Regarding the Big Cottonwood plant, Mr. R. M. Jones, Engineer and Manager of the Company, writes: "Our custom from the first has been to shut down the station absolutely between 12 m. and 1 o'clock in the day, every Sunday, and it has also been our custom to travel over the entire length of the line as often as twice a month in the night during stormy weather, if storms occur during the month. The object of this is to ascertain the location of any leaky insulators, which is readily determined by a spark something like that of a firefly, and from that,

larger, during damp weather. This can only be seen in the night. We have no difficulty by burning out or by capacity loss in allowing such leaky insulators to remain until the following Sunday and we know of certain ones that have been permitted to remain in use over a month. They usually char the insulator pin, but cause no further trouble. I would imagine it a very unsafe proposition to attempt to mix up in any manner with high pressure lines when they are working up to a voltage—our potential is 11,600 volts. Lightning and the combination of small boy and barbed wire fencing are our only source of annoyance or trouble."

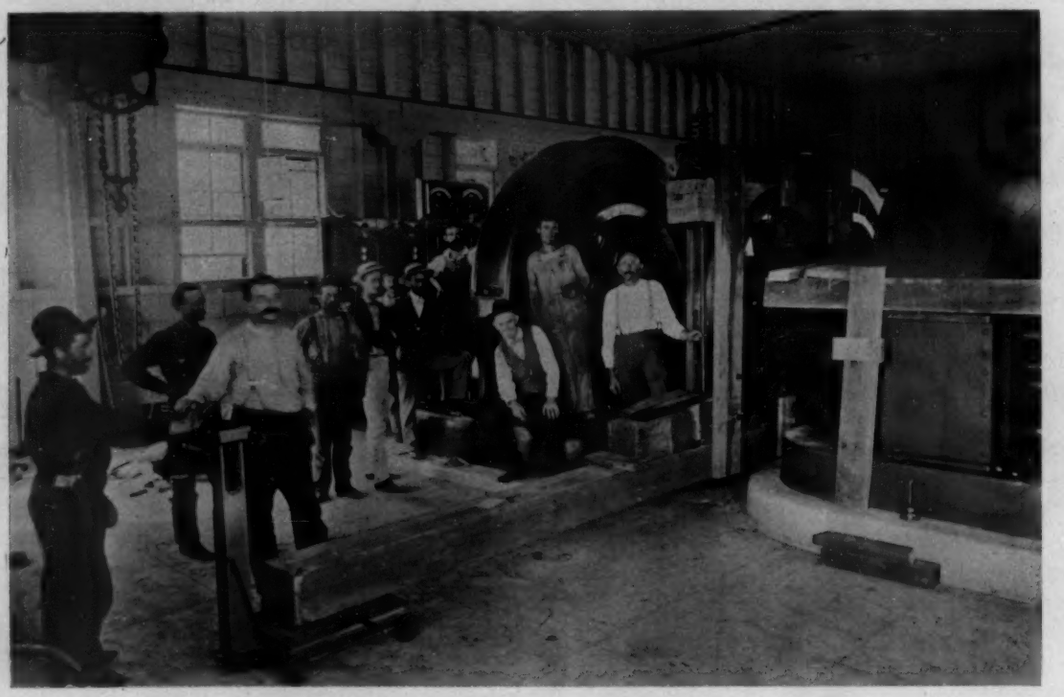
However reluctant managers are to change insulators on live lines, it is evident that this reluctance is due solely to the personal danger attending the work of changing, and as the method about to be described is designed to eliminate such danger, it proves of interest. The method is due to Mr. Wm. B. Jackson, of the Peninsular Light & Power Company, of Detroit, Mich., who in describing it, states:

"The method I use in changing insulators upon the 10,000-volt circuit is extremely simple, but, at the same time, quite safe, if due precautions are taken to have the apparatus dry.

"We use a 30-foot ladder, in two parts, so as it can be made of the proper length to catch the cross arm. At the upper end a small board is put on, having a hole in it of the right size to fit on the end of the cross arm. For the ladder to stand upon we have a platform 30 by 30 inches square, having a lower part which has a pin with an insulator at each corner and an upper part which fits upon the insulators in the lower part. This upper part has two recesses for the feet of the ladder to fit in. When the ladder is in place, someone goes up and screws a small hand-vise upon the cross arm. The hand-vise is of iron and has a piece of copper wire soldered to it. This wire is touched to the line wire upon which the broken insulator is located, and if everything shows all right, is wrapped around same. A three-foot stick boiled in paraffine is used in first touching the wires together. When the grounding wire is properly on, the man goes to work with bare hands and changes the insulators, when the grounding wire is taken off and the clamp removed.

"With a plant such as we have, it is an absolute necessity to be able to change the insulators at any time. The only time we can shut down without causing our customers trouble is between 3 and 4 p. m., on Sundays, and a bad insulator cannot be left from Monday till Sunday; at least, should not.

"We have not found it necessary to take the voltage off any portion of the system for two months and fourteen days."



A 750 HORSE POWER PRONY BRAKE.

Part IV

A PRONY BRAKE EXPERIMENT.

In making the test of the Girard water wheels installed in the power house of the Power Development Company of Bakersfield, Cal., it was deemed advisable to measure the output of the wheels direct without reference to the generator with which they were direct connected and although it was not believed that it would be possible to absorb 750 horse-power by a prony brake, under the conditions which existed, it was thought best to try the experiment at all events.

The wheel upon which the brake was applied was the Girard governor wheel located on the shaft as shown in the illustration. It is 6 feet in diameter, having a 10-inch-crown face, and ran at 257 revolutions per minute. The manner of rigging up the brake is clearly shown. The lower horizontal arm was something over thirteen feet in length from the center of the shaft to the center of the bearing on the scale, the length selected being such that a pressure of 1½ pounds on the scale represented one horse power of work done by the water wheel.

No water could be used for cooling purposes on account of the surroundings, hence the heating effect was excessive, and owing to the heavy section of the rim of the wheel, it became impossible to conduct the heat away or to dissipate it in any manner.

The experiment proved a failure, however, because of the burning of the wooden shoes. While this result was foreseen as probable, as stated, it was hoped that the heat generated in the small time required for a trial would not be of too great an intensity to render the apparatus inoperative. So much time was, however, required to handle the brake in adjusting the water wheel to the proper load and speed, that sufficient heat was generated to char the brake shoes to such an extent as to render them totally unfit for service. The spectacular effects of the experiment were startling, for with the scream of the brake, the spitting of fire and the vicious smoking of the timbers, the scene was one ever to be remembered.

Had water been available, or rather had it been possible to have applied water to carry off the heat generated, no trouble would have occurred, as a similar brake has since been used at the same place with water applied and fine results obtained. In this latter experiment, 125 horse-power was absorbed from a pulley having a diameter of 18 inches, with a 12-inch face.

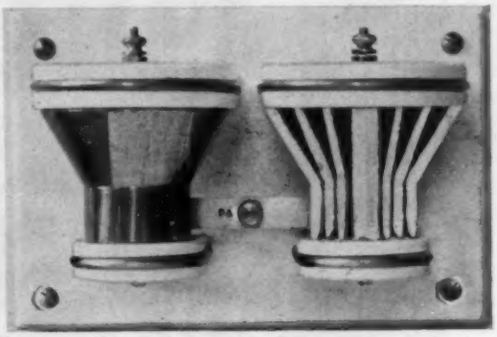
Part v

A NOVEL LIGHTNING ARRESTER.

The Stanley Electric Mfg. Co. of Pittsfield, Mass., have always borne a reputation for originality of design, and the new "S. K. C." Lightning Arrester shown will in no wise detract from this reputation. This instrument is brought forth as the result of many experiments and with an appreciation of the successes and failurees of the past. The one illustrated is of the indoor type, mounted on marble, the right hand set of cylinders having been cross-sectioned for the purpose of showing the construction.

Briefly, the arrester may be described as consisting of a nest of four concentric cylinders of non-arcing metal, the inner one being solid and the three surrounding ones hollow with "flaring" or conical tops. These cylinders are held in position between two perforated plates of vitrified porcelain provided with grooves in which the cylinders rest. The whole being securely clamped together by screws passing through the porcelain plates into the centre cylinder. The outer cylinders of each pair of arresters are connected by a brass bar, to the middle of which the ground connection is made; the line connections being made to two terminals which also serve to hold the upper porcelain plates in position.

The arrester, as shown, is a 1000 volt double-pole unit and in operation the two legs of the lines are connected to the upper terminals of the innermost cylinders, the ground connection being made to the cross bar attached to the outer cylinders of each pair. When the potential of the line is increased by lightning, the charge is met in the arrester by three spark gaps formed by the annular air spaces between the four cylinders and on reaching the outer cylinder escapes harmlessly through the ground connection. To provide against the maintenance of the arcs, a feature which has heretofore been so disastrous to lightning arresters, openings in the porcelain plates have been provided. These being placed so as to be opposite the annular air space or spark-gap between each cylinder, a draught or current is formed by the air which has been heated by the arc, and the latter carried up, by this means, to the rapidly widening



INDOOR TYPE.

gap is instantly and effectually dispelled; thereby preventing any escape of the line current to the ground. This feature is an important one and provides an unfailing "blow-out" arrangement similar to that of the magnetic blow-out which forms an important part of most modern direct current arresters.

In the types of alternating current arresters heretofore on the market, cylinders or balls have been used, and as the discharge will always occur across the shortest gap, it will take place along a single line or element with the use of smooth cylinders, from a number of points with the use of knurled cylinders and from a single point where balls are used. After each discharge the surfaces of discharge become oxidized or blackened which introduces a high resistance and impairs the usefulness of the arrester, causing the lightning to take a path of higher resistance, the usual practice, when this occurs, being to turn the cylinder or balls after each discharge in order to present a new surface. In the "S. K. C." Arrester, the cylinders being placed concentrically and the discharge occurring between any one element or line of the cylinder, there may be said to be an infinite number of paths provided for it to take, doing away entirely with the necessity of turning or disturb-

ing in any way the cylinders.

The "blow-out" arrangement also effectively prevents the fusing of the spark gaps which has been so destructive and not by any means infrequent in other types of arresters.

These arresters are capable of being arranged in groups for any line voltage. The indoor type is highly finished and mounted on a polished marble base, the outdoor type, in addition, being provided with a neat iron case and arranged to be hung on poles, where they are installed along pole lines, or in any other convenient place.

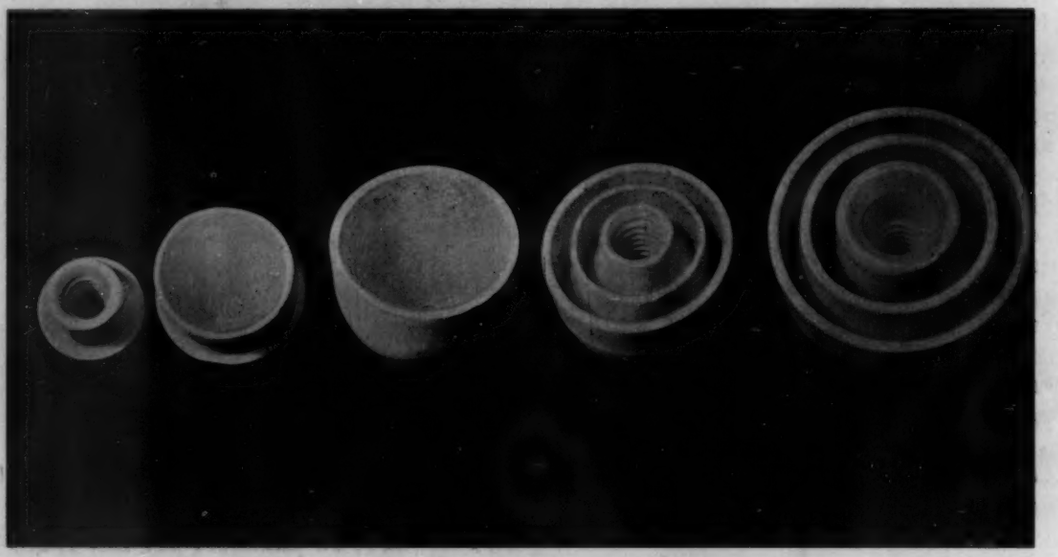
Part vi

A MULTI-GLAZE INSULATOR.

It has been pointed out in papers read before the Pacific Coast Electric Transmission Association to the effect that the puncture resisting properties of a porcelain insulator for use on high potential lines depends largely, if not entirely upon the quality of the glaze with which it is covered and the thoroughness with which this glaze is applied. Some have contended that inasmuch as an insulator with chafed or damaged glaze is liable to absorb moisture and break down, the glaze alone constitutes its chief insulation and that to it, and not to porcelain must be attributed the puncture-resisting properties of the modern porcelain. Others, in admitting that this is so, go a step further and contend that inasmuch as glazing is but merely a coating of glass, why not make the insulator entirely of glass and be done with it. But the porcelain insulator is too strong a favorite to be supplanted with glass or any other material without a struggle and it must be admitted after reading the description of a new porcelain insulator, published below for the first time, that the insulator of ordinary form may be vastly improved upon and even made to closely approach the glass insulator as a puncture-resister without losing any of the advantages which porcelain possesses.

The Boch porcelain insulator for extremely high transmission voltages is made in three shells of porcelain of such sizes that one fits closely into the other and, after being cemented together, forms a solid insulator closely resembling the ordinary procelain type in outward appearance. These three shells are glazed outside and inside most carefully, hence when they are put together and solidly cemented by a thin layer of melted glass, there are intervening between the wire and the pin, six skins of glaze and two layers of glass. In marked contrast to this is the ordinary insulator having but two skins of glaze between the wire and the pin.

The advantages of the Boch insulator are manifest. It retains all the merits of porcelain as an insulating material; it is as impossible to puncture it as it is impossible to puncture glass, for, as is also the case with glass, extremely high potentials jump over the surface of the insulator to the pin rather than go through it. Moreover, injury to the glaze ruins a porcelain insulator of the ordinary form, while with the Boch insulator, should the outside shell absorb moisture, the two layers of glass, together with the remaining five layers of glaze, will unfailingly prevent the passage of current from wire to pin, in addition to making it absolutely impossible for the moisture to penetrate beyond the outer shell. It is surprising, too, how solidly the glass, to all intents and purposes, cements the three shells together into a single solid insulator. In the half-section illustrated, a six-inch insulator was split down from the groove on top by a cold chisel as effectually as though it were of solid porcelain.



THE BOCH MULTI-GLAZE INSULATOR.

The cuts herewith were made from sections of the Boch insulators kindly loaned for the purpose by the California Electrical Works, San Francisco.

Transmission

AN ANSWER TO MR. SUTCLIFFE'S QUERIES.

By Alexander Jay Wurts.

THE papers on "Protection Against Lightning," in the November issue of the Journal of Electricity are exceedingly interesting and offer substantial material for reflection and study.

Referring to the five inquiries at the end of Mr. Sutcliffe's paper: The occasional sudden changes in speed of generators, together with the violent fluctuations of current and e. m. f. at the moment of a lightning discharge, justify in a measure the questions which have been proposed. I would not, however, explain any of these phenomena by the "damming back of a current."

A sudden falling off in speed is, I think, sufficiently explained by a short circuit.

A sudden increase in speed is explained by a sudden decrease in the load.

A marked rise in potential in the system can be produced by switching, particularly under light load conditions, or by the melting of a fuse.

The rise in potential is due to the well known phenomenon of field discharge from the converters.

My experience leads me to believe that static discharges from overhead wires are seldom of sufficient strength in amperes to melt fuses of any considerable size. When the wires are actually struck by a lightning discharge, which is a very rare occurrence, the fuses are liable to be melted. Ordinarily, however, the discharges are exceedingly minute, as compared with lightning and

ELEVATION OF PARTS OF THE BOCH INSULATOR.

are easily comparable to discharges from a large battery of Leyden jars.

The rise of potential, which as explained is due to "field discharge," and which has given birth to the idea of a "damming back of the current" and a "bursting effect" like the sudden shutting off of water under momentum in a pipe, will undoubtedly strain the insulation and may not infrequently be the cause of mysterious breakdowns. But danger from a rise in potential is not comparable to the danger from a surging static charge in the line wire.

The relative danger of lines traversing an elevated portion of the country and to those which lie lower, is a question which I have made the subject of a series of experiments covering two seasons. The results of my observations have led me to believe that there is no marked difference.

The question as to whether there is any feasible, simple

SECTIONAL VIEW OF THE BOCH MULTI-GLAZE INSULATOR.

method of protecting transformers scattered over a distributing system, would seem to indicate that protection on distributing systems has thus far proved a failure. Although accidents will happen, still I am of the opinion and believe that the average experience will bear me out in this statement, that an effective form of lightning arrester connected and carefully grounded to every 1000 feet of wire, will prove a perfectly feasible, simple and highly effective method of protecting high grade, that is, well insulated apparatus on distributing systems. I would define as an effective form of lightning arrester, one that will offer a relatively low resistance to the passage of static discharges.

I trust that the above will sufficiently answer the questions that have been brought forward.

Correspondence

ACETYLENE AND TRANSMISSION INTERESTS.

To the Editor:—I notice in the issue of the Journal of Electricity for October last, an extract from a German paper which discusses the explosiveness of acetylene.

The gas trusts have been working this explosive business for all that it is worth, and the impression seems to have gone abroad that acetylene is also a menace to electrical interests. I am inclined to believe that with all the maligning influence of the gas trusts, acetylene gas is going to come to the front in the very near future and I also believe that so far as electric transmission plants are concerned, it will not prove a menace to them in this State, owing to the great distance from the source of manufacture.

I have investigated the subject to some extent and I am inclined to believe that the greatest use to which electric power will be put in California in the not-very-far distant future, will be in all sorts of electro-chemical and electro-metallurgical purposes. I believe furthermore that we are entering upon a new field of industry in this line and that the development of our vast water power resources will be called upon largely for such purposes as those above named.

J. S. E.

Transportation

THE MOUNTAIN RAILWAYS OF SWITZERLAND.

By A. Van der Naillen.

CONSIDERABLE interest attaches to the development of the electric railway in Europe for the scaling of high mountains. These roads are principally in Switzerland, where tourist travel is immense, so great indeed, that as many as half a million tourists often cross certain points of interest in a single day. It is well known that Switzerland is the ideal country for water power because of the innumerable waterfalls that forever descend from the eternal glaciers. Electric power is most advantageous for this class of work on account of lightness, as compared with the steam locomotive, its economy of operation from the water powers, its freedom from smoke, soot and cinders, and its popularity with the general public. For these reasons electric traction has been adopted as the motive power for all roads recently constructed, in process of construction, and projected in the region of the Alps.

The line of Burgenstock, near the Lake of Lucerne, reaches a height of 2600 feet in a distance of 2700 feet, the grade being from 32 per cent to 38 per cent. The cars are propelled by a cable operated by electric motors, the power house being over two miles from the railway. This power house contains a 300 horse power turbine which drives two dynamos connected in series and giving a potential of 1600 volts for transmission by bare wires to the summit of the road, over two miles distant. At the summit is the motor house, containing two motors, running in series with each other and the line, and driving drums upon which the cable is wound. The cable draws up the cars at the rate of two miles an hour.

Two other electrically operated mountain railways of Switzerland are those at Strauserhorn, also near the Lake of Lucerne, and which ascends 5000 feet in a distance of a mile and a half with grades from 30 per cent to 62 per cent,—the power house being two miles distant—and the electric railway which scales Mount Salvadore. This mountain rises alongside the Lake of Lugano and the road reaches about the same altitude as the railway of Burgenstock, just described. The Mount Salvadore road, however, has grades of from 17 per cent to 60 per cent, but it is divided in two sections so arranged that while one car is descending, another car is ascending on the other section. This road is also operated by cables wound on drums as in the Burgenstock road, but the power house is about three miles distant from the motors.

The most important mountain railway now under construction is that by which it is proposed that tourists may ascend the famous Jungfrau with ease. This Jungfrau road will reach an elevation of 12,500 feet and its length will be six miles, of which five miles will be in tunnels. The last station will be underground exactly below the summit of the Jungfrau and from there and upward the shaft will be built two hundred feet high to the very summit, whither the tourists will be hoisted by an electric elevator. These are some of the principal electrically operated railways being built in Switzerland, and their attractive features draw millions and millions of tourists to that country each year. These railways have proven good investments.

If we do not do so, will not our children attract further tourist travel to California by inaugurating a series of similar improvements in our incomparable Yosemite Valley, or through King's River Canyon, or up Mount Shasta?

Traction

SUPPLANTING STEAM WITH ELECTRIC TRACTION.

ANOTHER step forward has been taken in the use of electricity for switching purposes on the steam railroad, in place of the noisy drill steam engine. This time it is on the Hoboken Shore Road, Hoboken, N. J., the full name of which is the Hoboken Railroad Warehouse & Steamship Connecting Company, and the line runs from Seventeenth St., Weehawken, to Fourth St., Hoboken, along the water front, or from the Erie tracks at Weehawken to the docks of the North German Lloyd Steamship Co., Hoboken, a distance of about two miles.

This road was opened for traffic on September 20th, 1897. It was constructed to provide connecting facilities between the tracks of the railroad companies entering Hoboken and the numerous warehouses and docks which line the West side of the North River from Hoboken to Weehawken. It is double track over a private right of way from Seventeenth to Fourteenth Street, single track down Hudson Street to Eleventh Street and double track along the River Walk to Fourth Street.

The switching of the cars for the past three months has been effected by a repair car of the Hudson County Electric Railroad Company. The new locomotive was put into regular service on the 4th of January, 1898, hauling trains of loaded and empty freight cars between the docks and the Erie track. The difference in its operation from that of the common drill engine is immediately noticeable. The electric locomotive responds instantaneously to the movement of the controller han-

dle and starts without jerk or noise, tightening up the couplings uniformly or coupling the cars together so gently that no blow is perceptible.

The locomotive was constructed in the shops of the General Electric Company, at Schenectady, N. Y., and somewhat resembles in appearance the electric locomotive in use on the Manufacturers' Railroad, which connects with the N. Y., N. H. & H. R. R. tracks at New Haven, Conn., and the giant locomotives now handling the entire freight traffic of the Baltimore & Ohio Railroad, through the Belt Line Tunnel at Baltimore. It is mounted on two four-wheel trucks, each axle carrying a General Electric 2000 motor, giving the locomotive a total of 540 rated h. p. The weight on the drivers is 57,200 pounds: the draw bar pull is 10,000 pounds. The locomotive is driven through a single reduction gear of very low ratio. The speed is correspondingly low, and is rated at eight miles an hour when hauling a heavy load.

THE HOBOKEN ELECTRIC LOCOMOTIVE.

At each end of the locomotive is an automatic coupler, and a small railed platform for the brakeman in charge of the trolley pole. The cab is of iron and resembles a double steam locomotive cab, with a sloping tender shield at each end. Drop windows are set around the four sides of the cab, affording an unobstructed view in all directions to the motorman. A sliding door at each side gives admission to the locomotive. The interior of the cab is lined with cherry and is a spacious and well lighted room. The fittings are all of polished brass or nickel. On each shield is a head-light; in addition, one shield carries a bell, the other a chime whistle. Beneath one of the shields are four packed card resistances, two sand boxes, the compressed air tank and the equalizing air tank; beneath the other are eight resistances, two sand boxes and the engineer's tool box. At one end of the cab is placed a controller of the series parallel type known as the L-2. It contains, of course, the magnetic blow-out and is arranged to operate the motors, either four in series or each two in series-multiple. Besides the controller is the air brake handle and the two valves of the sanding arrangement by means of which the sand is blown by the compressed air under the wheels.

In front of the motorman is an air brake gauge and above it an ammeter reading to 500 amperes. Fastened to the roof of the cab is an "L" automatic circuit breaker set at 500 amperes. On the other side of the controller, from the motorman, is an "M" circuit breaker and an automatic governor switch for the air pump, placed at the other end of the cab. This is a single cylinder pump driven by a 3 h. p. iron clad bipolar slow speed motor, and the operation of the air pump is automatic. When the air in the tanks is at normal pressure the governor-switch is opened, but blowing the whistle, applying the brakes or using the sander causes the pressure to fall, which closes the switch automatically and starts the motor and pump. The cab is lighted by five standard Edison railway incandescent lamps.

The overhead wire is No. 00, suspended from wires strung between octagonal cedar poles, except at two or three points, where bracket construction is used. Where the locomotive turns in from Hudson Avenue to the River Walk, a peculiar condition has caused a special method of bracket construction. It was necessary for the overhead line to be so set as not to infringe upon the limit of the next property. Thus at this point the overhead line is suspended from two bracket arms, one 6 feet and the other 18 feet long. The current for the road is taken from the station of the Hudson Electric Light Co.

Continued on page 83.

THE JOURNAL OF ELECTRICITY.

An Illustrated Review of the Industrial Applications of Electricity, Gas and Power.

OFFICIAL ORGAN OF THE PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION.

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EDITORIAL.

THE TENDENCY OF ELECTRICAL PROGRESS.

The Electrical World, (Vol. XXXI, No. 1,) in an interesting review of the present tendencies of electrical progress, points out that the evolution of the electric arts from their small beginnings, a half century or more ago, has been a singular story of progression, first along one line and then another, changing, as the accumulation of knowledge crystallized into coherent theories of electrical action, into a more purposeful growth. To-day the development of the heavy-current applications seems to be on the eve of transition—apparently returning to the simple principles of the very earliest days, and discarding much that was the product of hard study and harder labor in its perfection.

When the first dynamos were built it was found necessary to introduce a device for straightening the pulses of current that flowed from their armatures first in one way and then in another, into an orderly current, something like that given by Volta's pile or Galvani's "Crown of Cups." The commutator was invented, elaborated, and, after much travail, perfected as far as such a thing could be perfected. Electricians viewed the chaotic currents emanating from the whirling wire with disfavor. They would not energize an electromagnet, they would not work a telegraph, so the commutator was called into being to rectify them. Later, when motors had progressed beyond the stage of scientific curiosities, commutators were used upon them to again distribute the straightened current into its elements.

Henry and Farraday had found out that pulses of current induced others in neighboring conductors. Ruhmkorff had made the secondary conductor long and coiled it many times about the primary. Finally somebody reversed one of his coils and found that "intensity" currents could be made to give "quantity" effects, as well as vice versa. This was the first step in the progress of the alternating current. Jablochkoff and Gaulard and Gibbs and others of that day worked out a system of alternating-current lighting, while Siemens and Von Alteneck made dynamos that were the medical magnetic shocking machines of former days grown to larger proportions. From these small beginnings, by slow steps at first, the modern alternating and polyphase systems have sprung.

To-day the commutator is sinking slowly into comparative obscurity. A new race of dynamo mechanism has grown up, commutatorless, of the original simplicity of the sine-wave current. It is a return to first principles, a going back to the current conditions that puzzled and appalled the early experimenters, and caused them to devise the rectifying sliding contact machine that has given such a world of trouble ever since. Who is there to-day who shall say that the direct current is the normal variety or deny the alternating its claim at least to priority of origin? At best turning it into direct current was a makeshift resorted to in the early days, because it was not then known how to utilize it in its original simplicity. Happily we are now learning how, and the obvious and manifold advantages of the alternating current are beginning to be appreciated.

It is in this direction that one of the most evident tendencies of present progress is directed. The great lighting stations are changing over from the complex methods formerly in vogue, to the simple and satisfactory polyphase system of generation and supply. Long-distance power transmission is a commercial possibility only for the alternating current. The last stronghold of the direct curent, the railway, is now being invaded by its rival, and before many more years shall have passed the applications of direct current will be restricted to those uses for which it alone is fit. Even the one advantage of the direct current, long contended for, the possibility of its use in connection with accumulators, is nullified by the rotary converter.

There is no other tendency so conspicuous as this. The substitution of alternating for direct-current methods is becoming more and more widespread. The great installations now under construction are practically all of the alternating type. In railway work the day cannot be far distant when the commutator motor will be regarded only as an evil memory. Even in telegraphy and telephony the alternating current is coming into use. Such to-day, seems the most marked direction of advance in the electrical field, and no doubt ensuing years will see the practical disappearance of much of the direct-current apparatus now used for many purposes.

The trend of electrical development indicates that the Pacific coast is destined to play a conspicuous part in the new order of things because of the great activity evidenced in the erection of electrical transmission plants. The incentives for pronounced progress in this direction are due solely to natural causes—to the presence of abundant water power and to the absence of low priced

fuel,—and there is but little room for doubt that the attention of the electrical engineering world will be always more than interested in the epoch-marking projects and experiences that will ever be found in the far west. It is these plants that embody the greatest advances in alternating current work, which is symbolic of the highest state of electrical development, and it is by such organizations as that of the Pacific Coast Electric Transmission Association that the greatest detail in the story of the new advance, is to be recorded.

THE FIRST CENTRAL STATION.

In November last, the London Electrical Review celebrated its twenty-fifth year of publication in a special number of unusual merit, and among the valuable contributions to that issue is one from Mr. Robert Hammond, M. I. E. E. on "Twenty-five years' Development in Central Stations," that virtually raises the question as to which central station belongs the credit of being the very first to sell electricity to the general public as a merchantable commodity. It is believed that this distinction belongs to San Francisco in the enterprise inaugurated and prosecuted to a successful issue by the late George H. Roe, who brought about the incorporation of the California Electric Light Company on June 30th, 1879, and at once commenced the building of the plant for furnishing electric light to the public.

The career of Mr. Roe, who died in Brooklyn, N. Y., on December 10, 1894, is so closely interwoven with the first development of central stations that it possesses unusual interest. When the California Electric Light Company was organized, the appliances that had been developed for the generation and application of electricity were most crude. This and the absolute novelty of the scheme of electric lighting made it almost impossible to induce capital to embark in any electrical enterprise, and it was with the utmost difficulty that Mr. Roe,—who was himself at that time a man of limited means,—prevailed upon a sufficient number of his friends to incorporate a company to introduce electric lighting in San Francisco. He finally succeeded, however, after a display of that indomitable energy which was a part of his nature, in getting together sufficient capital to install a plant, the capacity of which was limited to a small number of arc lamps. For several years the income of the company was wholly insufficient to pay the expenses which were incurred, and in order to raise the moneys necessary to keep the enterprise alive, assessments were resorted to. Some of those who had associated themselves with the business did not have sufficient faith in it to pay the calls made upon them; one by one they retired, and it seemed for a time as if the money which Mr. Roe had invested himself and had induced his friends to invest would prove a total loss. He had great faith in the future of electricity as an illuminant and as a motive power, and never doubted for a moment his ability to demonstrate its desirability and practicability for those purposes, if he could succeed in keeping his struggling enterprise alive.

After three or four years of reverses and hardships the business began to assume more importance; one small dynamo after another was added to the plant, the lines of the company were extended from time to time, so as to cover additional territory, and in a few years business men came to realize that the California Electric Light Company was no longer an experiment, but a success and while others rendered assistance in the accomplishment of this result, it is not unfair to them to say that to Mr. Roe is due the principal credit of the success which the California Electric Light Company achieved.

In 1891—the business of the California Electric Light company being confined almost exclusively to arc lighting—Mr. Roe fully realized, and endeavored to impress upon his associates the importance of installing and operating an incandescent plant in San Francisco. The Edison incandescent system had been introduced in several of the cities of the United States, and had proven so successful that he realized not only the importance, but the almost imperative necessity, of the California Electric Light Company, or the people controlling that corporation, of acquiring the Edison rights for San Francisco. He sounded his associates, some of whom did not receive his suggestions with favor; but feeling that his course was the right one, he took upon himself the responsibility of making a personal contract with the Edison Company. The directors of the California Electric Light Company, after a thorough investigation into the value of the rights which he had secured, accepted and approved his contract, and out of this arrangement grew the organization of the Edison Light & Power Company, in 1891, which has since been succeeded by the present San Francisco Gas and Electric Company.

An incident in the early efforts of Mr. Roe to establish the pioneer central station of the California Electric Light Company, is told in the following excerpt from a personal letter addressed by Mr. Roe to the writer:—

"The California Electric Light Company was incorporated June 30th, 1879. At that time electric lights had been in use in mills and factories, where the power was available, but no building had been put up in any city for the purpose of distributing light throughout the city. Our people, that is to say, the writer, and other incorporators of the company, being unable to obtain any information regarding the business of electric lighting because no electric lighting had been done, determined to ascertain whether the business of renting lights could be made profitable; and for that purpose built a station, if station it could be called, for the purpose of ascertaining: First, whether it was practical to distribute lights throughout the city to the different people; and second, whether the people would take these lights and pay a price for them that would show a profit.

"Naturally, the cheapest building was constructed, simply 4x4 uprights, a wooden floor laid on the ground, the sides of the building covered with sheet iron; and the building itself in the rear of where the Flood building now stands and the entrance to which was through a tunnel. The boiler, engine, dynamos, oil house, coal-pile, and everything was huddled together in this one enclosure—as I said before, as cheaply as it was possible to do it. We realized at the time that the expenditure we were then making was merely experimental, and would be of no value if the business amounted to nothing.

"The machinery was stopped at midnight; no watchman was

engaged; the building was in the rear, so that it could not be seen from the street; and we have never been able to determine whether, in raking out the fire before shutting down, some coals were left on the floor, which was saturated with grease, or whether some tramp came in to lodge; but we do know that on the morning of April 24th, 1880, the fire took place. The apparatus was damaged of course, but we congratulate ourselves that the fire took place when it did, because we otherwise would probably have made temporary additions to the building, and would not so soon have constructed a proper station. There was no insurance on the building; we did not ask for any. We were making an experiment, and we realized what we were doing.

"The engine that was in that fire is now (September, 1892) in use in our Station A; the boiler that was there used is also in use in Station A; of course, having new tubes and other repairs. Some of the dynamos that were there in use, that came through the fire, and were destroyed so far as ninety-nine dynamos out of a hundred are destroyed by fire, were repaired by ourselves, and are now and ever since have been in use in our Station A, and practically as good as though the fire had not occurred. The repairs to them simply represented the wire and labor of winding, less the amount we received for the old wire taken

The claims of Great Britain for the distinction of being the country in which the first central station was installed, appear to be settled in the paper of Mr. Hammond, heretofore referred to, which states that "the honors of the title of 'first central station,' in the United Kingdom must be divided between the Holborn Viaduct and Brighton Works, both of which were established in the year 1882." The Holborn Viaduct station was started, states Mr. Hammond, early in 1882 and went out of business in a year or two. The Brighton station was inaugurated in February, 1882, and in 1894 its business was absorbed by the Brighton Corporation.

The Brighton station in England, and the California Electric Light Company's plant in California, appear therefore, to occupy analogous positions in that they were pioneer stations which have become permanent institutions, though having been absorbed into other industries. The priority, however, undoubtedly rests with the San Francisco station, and now, it may be asked, is there any electric central station in the world that can antedate its organization—June, 1879,—or its actual operation in the summer of the same year?

Passing Comment

An Editorial Review of Current Events and Comtemporary Publications.

REMINISCENCES OF EARLY ENGLISH STATIONS.

The contribution by Mr. Robert Hammond to the quarter-centennial edition of the London Electrical Engineer also contains many interesting references to the earliest experiences in electric lighting in Great Britian and the article throughout forms very entertaining reading. Truly many of the "old-timers" will recall parallel experiences to that cited by Mr. Hammond who states:

"Cockermouth was the site of an early central station, this being put down for the public lighting of that town in 1881. I had undertaken this contract, and in the dearth of capable assistants that then reigned, I was at my wit's end to know who to send to superintend the work on the spot. At this juncture a man entered with a letter of recommendation of a flattering nature. 'Could you go to Cockermouth by the 3 o'clock train,' I asked. He replied in Yankee drawl, 'Waal, I went to Singapore at four hours' notice, and I guess I could to Cockermouth at five.' Whereat he was dispatched and for some weeks we were in receipt of glowing reports of progress and applications for funds. On the eventful opening night excursion trains ran in from all parts of Cumberland, and the town was en fete. A switchboard was arranged outside the building so that the switching-on could be done in the sight of all the people. Mrs. Whittle, of Whitehaven, stepped forward to operate the switch, but alas, no light came. When they sought for the 'electrician' it was found that he had decamped, leaving a goodly amount of debts unpaid, and the arc lamps all connected up the wrong way. The crowd took the fiasco most good humoredly and amused themselves by parading the streets with lighted brooms dipped in tar, shouting "The only genuine Brush light."

Then again the observation of the builder of Kensington Court, "strikes home" to the pioneer when, in discussing the works laid out by Mr. R. E. Crompton for the lighting of Kensington Court remarked: "You electricians seem ready to supply everything connected with electricity except LIGHT. I can get any number of dynamos, engines, patents and lamps, but what I want for my buildings is LIGHT."

Of amusing, though in part pathetic, interest, is the reference made to Gaulard, to whose genius the original conception of the transformer is due.

"The development of electric lighting in London was largely assisted by an enterprise, the fortunes of which have been of very peculiar variety. In 1885, Sir Coutts Lindsay laid down an installation in Bond street to light the Grosvenor (picture) Gallery, and being applied to by some of the neighboring tradesmen, he turned his attention to public supply by means of overhead wires. The system of distribution was quite novel, then known as the Gaulard & Gibbs system, and now as the Alternating Current Transforming system. Poor Gaulard, the patentee, who afterwards died in a madhouse, was a most excitable enthusiast, and at one point of his carrer he certainly imagined that in his "Secondary Generator," as he termed it, he had solved the perpetual motion problem. I remember his calling upon me at the time of my conducting some experiments with the first Ferranti Alternators under Cannon Street Railway arches, and declaring that with the semi-portable engine that we had there he could light the whole of London. He denied that the utilization of the converted current had any effect upon the generating plant, and I at once suggested that it would be useful to fit up 100 E.H.P. of transformers in the arches, and run the alternator without the intervention of the engine. This sarcasm failed to shake his ideas, possibly because in my French it was somewhat veiled. However, his claims were so ludicrous that I declined to have anything to do with his system, a refusal which I afterwards had occasion to regret. Sir Coutts Lindsay made the first practical exhibition of it, but it went badly until, on the advice of Lord Kelvin, Mr. S. Z. de Ferranti was called in. He found the converters working in series and at once changed them to parallel working, which immediately proved highly successful."

SUPPLANTING STEAM WITH ELECTRIC TRACTION.

(Continued from page 79)

The dimensions of the Hoboken Locomotive are: Length over all, 29 feet; width, 8 feet; height over trolley stand, 13 feet; wheel base, 5 feet, 6 inches; truck centers, 12 feet, 9 inches; weight, 57,000 pounds.

The trial trip of this locomotive was witnessed by representatives of all the railroads having offices or termini in New York and New Jersey. The locomotive was coupled to eight loaded freight cars with an aggregate dead weight of 295⅝ tons, which it handled with ease. It was then coupled to a number of passenger coaches and the party made the journey over the line from Hoboken to Weehawken and back.

At the luncheon which followed, two interesting speeches were made. Mr. F. Le Bau, General Freight Agent of the West Shore Railroad, pointed out emphatically the usefulness of such a road as the Hoboken Shore Road in facilitating the transport of merchandise

IN THE CAB OF THE HOBOKEN ELECTRIC LOCOMOTIVE.

directly from the steamships to any part of the country, and of the rapid switching electric locomotive, by means of which the freight cars could be handled more easily and more expeditiously than with the ordinary steam drill engine. Mr. W. J. Clark, General Manager of the Railway Department of the General Electric Company, in an interesting talk full of reminiscences of the early days of the street railway struggle, said:

"Ten years ago, the development of three things made electric street railways practicable and profitable. These were the under-running trolley, the carbon-brush, and the modern method of motor suspension. The development of three other things now renders the general application of electricity to standard railroads both possible and probable. These are the safe breaking of heavy currents, high voltage for their transmission and methods for their application to almost any load on any portion of a line. Other features are being developed that will seriously affect the result; not the least is the Sprague system of multiple and unit control, increasing the flexibility of the already most elastic of all transportation agents, and while the economy of electricity has already been thoroughly demonstrated in performing the same service as by steam or animal traction, so far as passenger service at least is concerned, something beyond the mere question of economy has now to be considered, to wit: accomplishment by electrical methods of what would be entirely impossible with steam. The first steam railway man within my range of acquaintance to fully grasp this idea, is Mr. John Jundie, Consulting Engineer of the Illinois Central Railroad Company, who has set a pace on acceleration that would not have been dreamed of two years ago, and the schedule which he has mapped out for the contemplated electrical equipment of the suburban lines of his company involves a rate up to 40 miles per hour in 20 seconds. That this is practical has already been demonstrated. In fact so high a rate of acceleration has been made as 43½ miles per hour in 20 seconds, so that the practicability of Mr. Lundie's plans have been thoroughly demonstrated. This for passenger service.

"In another direction even greater changes may be prophesied which will come from the adoption of electricity in standard railroading, viz: the lengthening of freight trains and the consequent reduction in that most important feature of operating expenses—transportation wages. The advantages of electricity will have so thoroughly demonstrated themselves in the directions suggested that instead of main steam lines with electric feeders, in ten years it will be a question of electrically operated main lines with steam feeders through the sparsely settled districts, and a more extended system of suburban electric roads in densely populated districts also feeding the main lines.

"The electrical engineer has much to learn from the steam railroad man and must constantly rely upon him for suggestions as to the best methods of making practical applications of electricity. The American transportation man and the American electrical engineer should go hand in hand, continuing to lead the world as they now do in all transportation problems. The American engineer has won conquests abroad as well as at home, not the least is the solution of the problem of electrical equipment for the Central London Underground Railway, the most important of this character that has yet been accomplished. The American engineering plans were selected on account of their merit in the face of the severest competition from every European electrical manufacturing company, and no greater tribute can be paid to American engineering methods than to state that eighty per cent of all the railway apparatus used in Europe is designed in America, so that the American engineer stands to-day head and shoulders above those of any other country. With the encouragement of the co-operation of American railroad men he is bound to revolutionize the entire method of transportation within a comparatively short space of time, so that American railroad methods will then, as now, be in advance of those existing anywhere else on the face of the earth."

THE MAKING OF PORCELAIN INSULATORS.*

By F. A. C. Perrine, D. Sc.

By most writers on the subject, the material of porcelain is considered to be one of the two great divisions of ceramic ware, and it is distinguished from pottery by being more dense, whiter and less fusible, but particularly in being translucent. Indeed, many consider that translucency is the only means by which porcelain may be distinguished from pottery. Pottery is a ceramic ware molded from a paste of impure hydrated silicate of alumina, containing certain amounts of free silica, lime and iron. The product is opaque and invariably porous, on account of the removal of the volatile ingredients in the baking process. Porcelain, on the other hand, consists principally of a pure silicate of alumina only slightly hydrated, called kaolin, inclosed within a matrix of hard silicate glass. In the oldest history of the art the Chinese found pure kaolin in certain clay banks, and in other banks the ingredients for a silicate glass, which, being mixed together, molded and baked, formed what is called "natural" or "hard paste" porcelain. This was first imitated in Europe by "soft paste" porcelain, an admixture of the kaolinic clay with an artificial glass composed of a mixture of niter, soda, gypsum and salt, the proportion of kaolin to the glass being much less than in the natural Chinese product. Between these two lie the "mixed" or "bastard" porcelain, which are uncertain in character, but which are all composed of kaolin inclosed within a bond of more or less fusible glass. To this last class belong most of the American porcelains, although some of our potteries produce a material more like pottery than porcelain in porosity by mixing the ordinary grades of pottery clay with kaolin. When first baked, all of these materials are more or less imperfect over the surface, having much roughness and little luster, which surfaces must be finally protected by a subsequent glazing, the glaze consisting of nothing more than a thin coating of glass, which may be merely and entirely an artificial glass similar to that from which bottles are made, or a natural glass made by melting over the surface a powder of pure feldspar. We see then, in the first place, that the character of the insulating material depends upon the clays used and the percentages in which they are used, since by charging the ingredients we may pass from glass, which is melted and runs at a temperature a little above the red heat, through soft paste porcelains and mixed porcelains to hard-paste porcelains, which in the hardest grades cannot be melted at a temperature below 2,000 deg. Fahr. Pottery can hardly be ranged in this series, nor is it proper to range here the so-called porcelains containing pottery clays, for the reason that the materials from which these articles are made all contain substances of a volatile character, and furthermore, these clays are deficient in fusibility, so that the ware is necessarily porous on account of the volatilization of water and other contents of the materials as they are molded before baking.

The general process of manufacture of the insulator for an electrical line follows closely the processes that have been used in the manufacture of porcelain since the earliest times, with one important change, which is the result of modern inventive methods. The clays used are intimately mixed by grinding under water into a perfectly homogeneous mass, and after the superfluous water used in grinding has been removed by settling or filtering, the clays are molded into shape required for the finished articles by either "casting," "throwing" or "pressing." The operation of "casting" is the one by means of which we obtain thin egg-shell china so much admired in our dainty teacups. For this purpose a mold of plaster of paris is furnished, which determines the outside shape of the article to be made. This mold is filled with a so-called "slip" of clay, about the consistency of cream; the plaster mold immediately absorbs the water and holds on its surface a layer of clay, the thickness of which is determined by the time the slip is allowed to stand. When the articles are thick enough, the remaining slip is poured out, the surface smoothed by a delicate touch or two and the teacup is ready for drying and baking. Larger and thicker articles have from time immemorial been "thrown" on the potter's wheel. For this work the slip of clay is settled and filtered, and the remaining mass of wet clay molded and dried until the correct plasticity is obtained, when it is taken by the potter and whirled upon his wheel, while with his hands he guides the jug into the shape desired.

Modern invention has almost superseded the potter's wheel by the potter's press, and by this press the tough hard-paste porcelain can be made in thick objects without porosity, as was formerly only possible with glass and soft-paste material. For working in the press and to obtain a material of great density, the damp clay is further dried until it is in a powder which will not adhere in masses except under considerable pressure. This powder is then filled into a matrix and a core brought down; the sharp pressure consolidates the clay into the form of the finished article, the density of the resultant baked porcelain depending not only upon the proportion of the ingredients, soft and fusible, but also upon the amount of pressure applied; since as the pressure is increased the clay may be more thoroughly dried and smaller spaces left by evaporating moisture. Moisture cannot, however, be entirely eliminated from clay until it is subjected to the heat of a pottery kiln, and that this process removes a very considerable amount of water from the mass is shown by the fact that the shrinkage in baking amounts to about as much as the shrinkage in the cooling of cast iron, namely, a shrinkage of one-eighth in the linear dimensions. The spaces remaining are filled in the baking process by the fusible material with which the kaolin is mixed.

Whether "cast," "thrown" or "pressed," the articles made from clay are of consistency not different from that of a lump of clay until subjected to the heat of a pottery kiln, when the water of hydration is driven off from the silicate of alumina and any glass contained in the mass is fused, thus rendering the finished baked porcelain article hard and solid, the hardness and toughness depending largely upon the quantity and quality of silicate of alumina, while for the solidity we must look to the presence of a certain amount of fusible glass. The proper porcelain, therefore, for insulation is that in which there is only that amount of glass present which is necessary to fill up the porosity of the dehydrated silicate of alumina, since when this proportion is attained the greatest amount of strength consistent with non-porosity is reached. Should the amount of glass be increased beyond this point the porcelain will become brittle, although it will still be nonporous—but nonporous just as glass is nonporous—and hence without the advantage over ordinary glass supposed to be possessed by a hard-paste porcelain. If the amount of glass present is only so much as will fill up the pores left by the escaping water as the silicate of alumina is dehydrated, we can

* An abstract from an article in Electrical Engineering, Dec. 15, 1897.

readily see that such porcelain has no property by means of which wide cracks in the molded clay can be stopped up, since at no temperature available within the pottery kiln will the mass fuse and run. We may say that the glass is drawn by the porous silicate of alumina into itself by capillary attraction, and when spaces are present which are not capillary these spaces cannot be filled up; accordingly, we see that the solidity of the finished article in hard-paste porcelain manufacture depends upon the solidity of the molded clay, and we also see that it is erroneous to suppose that while the porcelain manufacturer can make thin articles which will be solid, it is impossible for him to obtain an equal solidity when heavy masses are dealt with. It is, indeed, more likely that the heavy articles will contain open spaces than that the latter be present in thin pieces, since whether the pressure is applied on the wheel by the hand or in the matrix by the die, it is easier to make solid a thin layer of the clay than a thick one, but at the same time that porcelain manufacturer who does not increase his pressure sufficiently to insure the solidity of thick pieces is not handling his clays properly, and the fact that certain makers are not able to produce heavy solid articles does not tend to prove that solidity is an impossibility where the clays are properly handled.

Another danger must also be avoided in the choice of a porcelain insulator of great weight, which is harder to detect than the presence of porosity, since the exact knowledge of the mixture of clays used is only possessed by the manufacturer himself. I am speaking now of the tendency toward the use of soft-paste porcelain by manufacturers whose machinery is not powerful enough to compress the hard-paste clay to a sufficient density for a perfectly solid heavy insulator. Of course, with what has gone before, we can at once see that should a manufacturer find that his mixture in heavy masses does not give a thoroughly solid product, he can at once add more glass, or glass of a more fusible character, reducing the amount of kaolin, on which we depend for strength. He will then obtain great solidity at the expense of toughness and strength. This is an error in the manufacture of insulators which can only be detected with the greatest difficulty, since the highest experts on porcelain wares are often at a loss to determine whether the body of an article is a hard or a soft paste porcelain without determining the crushing strength, and of course a mechanical test is exceedingly difficult to apply to such an irregular body as a line insulator. Even the chemist is here upon ground in which he is not sure, since the differences between the clays and the glasses are chemically so slight that the result of an analysis is of very little worth. While this is undoubtedly the greatest difficulty in the matter of insulators for withstanding high potentials and carrying lines of great weight, it is the point in which the manufacturers are deficient in their apparatus, since there is hardly a factory in the country which is equipped for pressing the heavy high-voltage line insulator more solidly than articles much smaller are necessarily pressed and in consequence it is probable that at the present time most of the manufacturers make an insulator which is either porous in a heavy body of the insulator head or that a much softer paste is dealt with than is used for smaller articles.

Should a manufacturer attempt to mix and press a hard-paste clay which shall give a thoroughly solid line insulator of the greatest size, he would also encounter the difficulty that clay when pressed is not a liquid body, and in consequence pressure applied in one direction is likely to produce cleavage lines in the insulator, and in consequence we may not at the present time say that insulators of the form now used can be made solid from dry hard-pressed clay without danger of the production of such cleavage lines, and in consequence we must use a softer paste until the proper form of insulator shall be developed, or perfect the molding of the hardest paste used in the driest possible state and sufficiently hard pressed for complete solidity after baking. These cleavage lines are especially apt to occur where irregularities in pressure are sustained by the mass of clay in molding. That such irregularities must almost inevitably occur will be evident to one who examines carefully any insulator with long thin petticoats; and furthermore, this same examination will point to a danger of the petticoat splitting away from the head of the insulator in baking, when, as has been said, the shrinkage of one-eighth occurs. The effect of this shrinkage is well known to ironmolders, and no competent patternmaker would attempt to join long thin plates to a heavy body without in some way taking care of their tendency to split away from each other when shrinkage occurs. In consequence, the most successful designers of articles for manufacture in pressed porcelain are those who have had thorough training in molding complicated cast-iron shapes. Whether the petticoats are broken away from the mass of the insulator in pressing or in shrinking when they are baked, we find that most of the failures of such insulators when pierced by high voltages occur along cracks which are found in the porcelain at about the point where the petticoat is joined to the heavy head.

Coming from the kiln, articles made of hard-pressed porcelain, however smoothly molded and however solid in the interior, are found to have a surface which is dull and somewhat rough, and where a smooth shiny surface is desired, glaze must be applied. Glaze is a glass applied to the exterior surface of the baked porcelain and fused on by subsequent baking. The glaze is perfect when it flows evenly over the surface of the article, and when it does not crack on coming from the kiln, or subsequently when exposed to varying temperatures. Cracking of the glaze is technically termed "crazing," and crazing is due entirely to a difference in the coefficient of expansion between that of the glaze and that of the underlying porcelain biscuit. It would seem at once to be the most reasonable proceeding to glaze our porcelain biscuit with the material of its body; but if this body is that of a hard-paste porcelain it is not sufficiently fusible for use as a glaze, and in consequence the surface must be covered with something more fusible. Accordingly, the selection of a glaze which shall have the same coefficient of expansion as that of the porcelain body is a matter of the greatest difficulty. This difficulty increases as the thickness of the glaze is increased, on account of the fact that while a thin glaze may have sufficient elasticity to give with movements of the underlying porcelain, a heavier body of glaze will not yield so readily.

That this should be true is apparent at once by the examination of a glass thread, which can be bent and even woven, while the glass rod from which it is made seems to be almost absolutely rigid. Tiles have been made with a glass face as much as one-sixteenth of an inch in thickness, but this was accomplished only after a long series of experiments, with repeated failures, and only on the surface of a rough tile made of porous fire brick. The natural hard-paste porcelain of the Chinese is supposed to be glazed with pure feldspar, but a more readily fusible glass is required by almost all the European and American porcelains, while for each porcelain body a different glass is required; and not only is there probably but one glass which will glaze a particular porcelain, but also that porcelain manufacturer is to be con-

gratulated for the care and success of his research after he has found a glaze which under no circumstances of changing temperatures will craze. Josiah Wedgewood spent many years of his life in ascertaining this fact and in determining the proper glazes for his different wares, while in this country thousands of dollars have been consumed by the different porcelain manufacturers in finding satisfactory glazes. In many cases such glazes have not yet been found, and in consequence but very few or our porcelain manufacturers can make a satisfactory line insulator without a crazed surface. That we should require a surface which does not craze is due to the fact that although we do not depend upon the glaze itself as an insulation, we do depend upon it for preventing the retention of moisture upon the surface of the insulator. The nonhydroscopic character of porcelain as compared with glass therefore depends upon the character of the glazing surface and also upon its mechanical perfection. There is here a danger in the use of some porcelains, that while when made the smooth glaze is nonhydroscopic, the glass necessary to use for glazing will be soluble, and when weathered will present a rough surface, even though no crazing should ever occur. Indeed, it is probable that all porecelain glazes will ultimately weather, since the hardest glass we know of is that made of pure feldspar, which, even a slight study of geology tells us, is destroyed by atmospheric influences, and this is an additional reason for turning our attention from the glaze to the porcelain body when we speak of insulation resistances; and even were this weathering of the glaze removed to a remote possibility, we do know that any glaze will be worn away from the insulator by the contact of the line wire which the insulator is destined to support.

Having now examined carefully the necessary details in the manufacture of porcelain for insulators, we are prepared to give some guide for the writing of proper specifications and the pointing out of tests which should be made upon a porcelain insulator in order to obtain the best product that our manufacturers can at the present time produce. It is useless for the engineer to attempt to limit the porcelain manufacturer to certain pastes or glazes, since the clays used by different makers, though bearing the same names in different parts of the world, are not at all the same inultimate character—one or two per cent difference in the amount of water contained by the kaolin changing the whole character of the mixture necessary in the production of hard porcelain. And, as we have said, a different glaze is required for each mixture of clay, therefore these details must be left entirely to the manufacturer himself, since he is better able to make the choice necessary for a successful product than any engineer, no matter how carefully the latter has studied the use of insulators and the manufacture of porcelain. But, at the same time, the user should endeavor to ascertain which manufacturer uses the strongest paste and produces the densest insulator. Strong pastes can be chosen from soft pastes by mechanical tests alone, and the ability of the insulator to withstand shocks as well as pressure should be carefully tested.

In applying electrical tests it seems foolish to attempt only tests upon the finished glazed articles, since if the glaze is perfect it will completely mask the most serious extent of porosity, and even twice the potential of the line may not pierce a defective insulator, which will fail during the first rainstorm after the glaze has been worn away by the wire. The proper time, therefore, to apply any electrical test to the porcelain insulator is while the insulator is in the biscuit and before it has been glazed. It is always perfectly easy to test for porosity and to stamp the accepted insulators under the glaze by a mark which cannot be counterfeited after glazing has been performed. Even a galvanometer test at moderate potentials in this stage will furnish more accurate knowledge of the state of the porcelain than a high potential test after the glazing has been applied. Especially is inspection at this time important, as the glaze will mask cracks as well as porosity, which cracks would be apparent to the eye of the inspector before glazing, although completely covered by skillful work in the glazing process. The final inspection of the finished insulator should turn upon the perfection of the glazed surface, although it is foolish to attempt to obtain an insulator glazed in every part, since the insulator must be carefully supported in the glazing furnace, and where it is supported the surface will remain rough. It is indeed possible to specify the position upon the insulator of this rough surface, but one cannot expect to obtain a piece of porcelain covered with glaze in every part.

Finally, it should be pointed out that the relative position of the wire and the petticoats demand some study, since if the petticoats are likely to be cracked away from the body of the insulator at their point of attachment with the head, it seems wise to remove the wire from this danger point as far as possible, although, of course, actual contact of the wire with a crack is not necessary for piercing through that crack, since the high potentials now used will leap along the surface of an insulator from three to five inches, and, in consequence, if the path from wire to pin through a crack is less than the sparking distance of the potential used, leaks will occur through a crack even though neither pin nor wire be in contact with it.

It certainly seems, therefore, that, although we may improve our present insulators by a careful study of their material and form, it is at present unnecessary to attempt any redesigning of the insulators in use until we have thoroughly tested the capabilities of our porcelain manufacturers to produce insulators of the present form which shall be sufficiently strong to carry the wire and sufficiently solid to prevent the escape of electricity through the body of the porcelain without reference to the character or existence of glazing.

Illumination

THE GAIN IN USING LATEST TRANSFORMERS.

THE economic results obtained by the substitution of old type transformers by those of most recent and improved manufacture, and by the use of one large transformer for several small ones, have been demonstrated very clearly and convincingly in a compilation of reports received from certain electric lighting companies which have made the change. In almost every case the change has resulted not alone in a far more perfect operation of the system, perhaps a minor consideration, but in an actual concrete, tangible saving in dollars and cents.

Improvement in transformer construction and the use of larger units follow naturally after similar developments already completed in the machinery of many of the large central stations of our country. The replacement of a large number of transformers of small capacity, manufactured when the art of transformer construction was not so well known as it is to-day, by a few im-

proved transformers of large capacity has produced, and is producing, results startling in their importance. The figures shown in the compilation are interesting and should compel the attention of the manager of every station supplying current through transformers.

The first instance is that of a company operating in a town of 56,000 population in Massachusetts. In this case 57 small transformers built in previous years were supplanted by 18 of one of the latest types. The total light capacity of the superseded apparatus was 1499 lights, of the newly installed transformers, 1624. The total core loss of the old transformers was 5866 watts; of the new, only 1348. So much for the electrical facts. The saving in dollars and cents is calculated as follows: 39,578 kilowatt hours are saved yearly by the change. The value of the saved energy may be estimated at $527.70—equivalent to a saving per light capacity per year of 36.2 cents. Neglecting all the advantages of the change, except those accruing from the decreased core loss, the expense will be met in one year and nine months.

The light capacity of the plant is increased 9 per cent, the core loss decreased 77.5 per cent. Furthermore, on account of the decreased core loss, not less than 4518 watts are available for sale at the regular rate with the present station apparatus. This enables the company to add ninety lamps to its circuits, producing an additional income of about $675.00.

The second instance is in another Massachusetts town. Here 40 new type transformers supplanted 53 old ones. The total light capacity of those returned was 1135 lights, of the new, 1070. The core loss in the old type transformers was 4845 watts, of the new type, 1343 watts. In this case the annual saving is 30,678 kilowatt hours, or about $409.00; and corresponds to a saving per light per year of 35.2 cents. The expense of the change, counting core loss alone, will be covered in two years and nine months. 3502 additional watts are available for sale, increasing the income to $525.00 per year, while by the use of lamps of a higher economy, some 535 kilowatt hours additional are also available for sale.

There are still three more striking cases, in Massachusetts, of benefits derived from a similar change. In the first, the regulation of the station had been so poor that the lamp bills had increased to such an extent that the question demanded immediate attention. While the saving was comparatively small, the beneficial results brought about by the change have proved highly satisfactory. In the second, 81 small transformers of old type were replaced by 3 of a new type. The core loss of the returned transformers amounted to 2568 watts, of the new ones, 280 watts. The resultant saving per annum is 20,043 kilowatt hours, or $267.00, the saving per light capacity per year, 25.74 cents. This is an all day station and it is calculated that only eight and a half months will be required to wipe out the investment. The third case involves the supersession of 103 old type transformers by 37 new ones, the total light capacity of the former being 6025 lights, and of the latter, 3210 lights. The total annual saving is 51,203 kilowatt hours, or $683.00, and the total saving per light capacity, 14.68 cents. In five years and two months the cost of the change will be fully covered. The capactiy of the plant has been increased 36 per cent, the energy required to operate it decreased 47.1 per cent. 5843 additional watts were made available and thus an additional capacity of about 116 lights was obtained without adding to the station apparatus. If these lights were burned but three hours daily the result would be an additional annual income of $060.00. On account of the improved regulation entailed by the change, high efficiency lamps can be used and about 410 more watts saved. This adds $109.46 to the total annual saving.

Several interesting changes have also been made in the West. One instance in particular merits attention. The details of the change are not available, but by centralizing the transformer distribution, the rate of switchboard income was changed from 4 cents to 12 cents per kilowatt. Another Western plant reports that its 1140 volt circuit equipped with old style transformers showed 6 to 7 amperes in the day time, while with the new transformers only a fraction of an ampere is shown.

Facts such as these tend to prove not only that constant improvement is taking place in electrical apparatus, but that station managers are realizing that, to secure the most economical results on their systems, such improved apparatus must replace older types built when electrical knowledge had not reached its present high standard. A saving here, less trouble there, the extinction of a difficulty at another point, result in a general benefit which can be exactly calculated in dollars and cents, and thus tends to the general well being of the pregressive station and communities in which the newer methods are adopted.

Personal

Mr. A. P. Brayton, President of the Pelton Water Wheel Company, has returned from the Hawaiian Islands, where he found full restoration to health.

Mr. M. E. Baird, general manager of the Eddy Electric Manufacturing Company, of Windsor, Conn., is making his annual tour throughout the West.

Mr. John West Thompson, Installing Engineer for the Mexican General Electric Company, with headquarters at the City of Mexico, and who is of the Stanford '95 class in electrical engineering, is in San Francisco.

Mr. H. C. Wybro has retired from the firm of Wybro & Lawrence, of Los Angeles and San Francisco, and has accepted the Pacific Coast agency of the Walker Company, of Cleveland, Ohio,, with offices at 53 Chronicle Building, San Francisco.

Mr. T. H. Macdonald, for many years chief engineer of the various steam stations now operated by the San Francisco Gas & Electric Company, resigned therefrom on December 31st last, to accept the chief engineership of the Hawaiian Commercial Company's steam plants on the island of Mauii, H. I. The high esteem in which Mr. Macdonald was held by his fellow workers found fitting expression on the eve of his departure, in a massive gold watch chain, with suitably inscribed diamond locket.

Mr. A. E. Brooke Ridley has returned to San Francisco from a two months' trip East and abroad. While in London he gave special attention to a study of the details of garbage cremation and to the utilization of heat therefrom for the operation of electric plants. Mr. Ridley was also successful in personally securing the Pacific Coast agency for the Electric Storage Battery Company, of Philadelphia, manufacturers of the Chloride Battery. This agency has heretofore been held by the Union Iron Works, although under Mr. Ridley's management.

Dr. N. S. Keith, so well and favorably known in electrical circles of the West, is a welcome visitor to San Francisco and will probably remain here for a month or two. Dr. Keith has been absent since 1893, when he went to Chicago to attend the World's Congress of Electricians, afterward continuing on to England, where he has remained most of the time since. His principal association was with the Sandcroft Engineering Works, near Chester, England, where constant current, high potential machines were built under the Keith patents for installation in many portions of Europe and Africa. Not the least of the distinctions due Dr. Keith is the fact that he is the founder of the American Institute of Electrical Engineers.

Fraternal

THE TRANSMISSION ASSOCIATION.

The third quarterly meeting of the Pacific Coast Electric Transmission Association is to be held at the rooms of the Association, 175-178 Crocker Building, San Francisco, beginning Tuesday, February 15th, next, at 2 o'clock, and to continue thereafter until the business in hand shall have been disposed of.

The principal topics for papers and discussion will be "High and Low Potential Switchboards," "Electric Hoists," and "Character of Motor Loads." These themes and the interest which is being taken in preparation for their consideration, vouchsafe a most interesting and profitable convention.

It is probable that the committee on By Laws and Constitution will render its report and that the organization of the Association will be permanantly effected.

Industrial

In Responding to Advertisements in this Publication, please mention "The Journal of Electricity."

A SERVICEABLE LAMP GUARD.

The incandescent lamp has worked its way into many uses that would not be possible were it not for the attachment known as the lamp guard, and a strictly first-class guard that may always be relied upon and which can be bought for a reasonable price, has long been "conspicuous by its absence," so to speak, from the electrical market. Now, however, there is little if any room for improvement either in price or quality of this most useful device, since the "Acme" wire guard for incandescent lamps has been placed on the market by Messrs. P. R. Wagor & Co., 275-79 Main St., Springfield, Mass.

The Acme lamp guard is simple, durable and easy to attach or detach, if desired, and it has gone into very general use even in the short time since it was introduced. The firm has very good reports from its customers and users, and finds that its guard business has already grown into almost phenomenal proportions.

Messrs. P. R. Wagor & Company will be glad to receive and answer inquiries concerning the Acme guard from all who are interested.

ORGAN BLOWING BY A ROTARY FAN.

The first electric organ pumping installation in San Francisco has just been placed in the Trinity Church.

The wind supply of the Trinity organ presented many difficulties on account of the impossibility of adopting either of the usual methods of mechanical blowing. The main bellows, which is situated in the basement of the Church, was constructed by Messrs. Hook and Hastings with the intention of pumping by hydraulic motor; but about the time the organ was shipped from Boston, it was discovered that no satisfactory arrangements could be made for a supply of water. An electric motor was suggested, but such machines usually work on a direct current, and this cannot be obtained in the neighborhood of Trinity Church. After consultation with the California Electrical Works, it was decided to try a new style Wagner electric motor of 2-horse power, working on an alternating current, such as already supplies the lighting of the Church.

The drawback to this form of motor is the impossibility of controlling or regulating the speed, which should, of, course, vary according to the quantity of the wind required to supply the organ. After several unsuccessful experiments one of the engineers of the California Electrical Works suggested dispensing with the usual method of pumping, and proposed to deliver the air to the bellows by a rotary fan. This novel expedient proved to be a complete success, and the wind is now supplied by a No. 4 Sturtevant blower, operated by the Wagner electric motor. It is likely that Trinity organ is the only one in the world blown in this manner, but the advantages of the new method are so great that in all probability it will come into general use. The wind is absolutely steady, and the rotary blower will supply more wind to the bellows than the usual feeders.

A NEW ELECTRIC SUPPLY HOUSE.

The latest organization to enter the electrical field in the West is the Pacific Coast Electric Company, of 241 Powell street, San Francisco, which has started in business with a number of important agencies, among which are those of the Okonite Company, Ltd., the Weston Electrical Instrument Company, the Central Electric Company of Chicago, the Fuller & Curtis Company and the Scheefer transformers. The principal members of the concern are T. M. Crane, formerly of the Edison Light & Power Company, President and Manager, J. J. Gottlob, vice president, and James Maloney, secretary.

The new company has well appointed offices, an unusually well selected stock, and, besides, possesses the essential attributes of long experience and personal popularity that are so vital to permanent success.

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